

§51. Development of an Ion Beam Source for a Low Voltage / High Current Neutral Beam Injector

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The Low-voltage and high-current neutral beam injector (NBI) is essential to sustainment of ultra-high beta STs at UTST device, which is one of core experiments for the all-Japan ST research project. The requested properties for the NBI are its beam energy <25kV, its beam current >20A, and low-beam divergence, while its pulse length can be as short as 10msec. We organized a new research team composed of Univ. Tokyo, Nihon Univ., Osaka Univ. and Kyusyu Univ. to develop the compact and maintenance-free ion beam source for NBI by combining the washer-gun plasma source techniques at Univ. Tokyo with the electrode design technique at Nihon Univ. and Osaka Univ. We will optimize the plasma source and the electrode system to complete the compact and cost-effective low-voltage/ high-current NBI.

In 2005, we developed (1) the plasma source by washer gun, and (2) the electrode system for ion acceleration and deceleration. Figure 1 shows the final design of our NBI system under development, which is composed of the washer gun plasma source, the plasma source chamber, the electrode system and the neutral cell. We completed the washer gun plasma source and most of the plasma source chamber, leading us to studying the properties of the washer gun plasma source. Figures 2(a) and (b) show the time evolutions of the gun current and the electron density averaged over 1m from the gun, respectively. The CO₂ laser interferometer result clearly shows that the electron density inside the plasma source chamber is 10^{18} - 10^{19} [m⁻³]. Unlike the conventional filament method, high-density plasma over 10^{18} [m⁻³] was obtained economically by the combination of the washer gun and the source chamber. The plasma duration time $\sim 100\mu\text{sec}$ is limited by the capacitor bank and gas puff. Based on these results, we will complete the test module of ion beam source around

Jan. 2007, and will start optimizing the electrode system for ion acceleration and deceleration.

References

[1] E. Kawamori and Y. Ono, Physical Review Letters, 95, (2005), 085003..

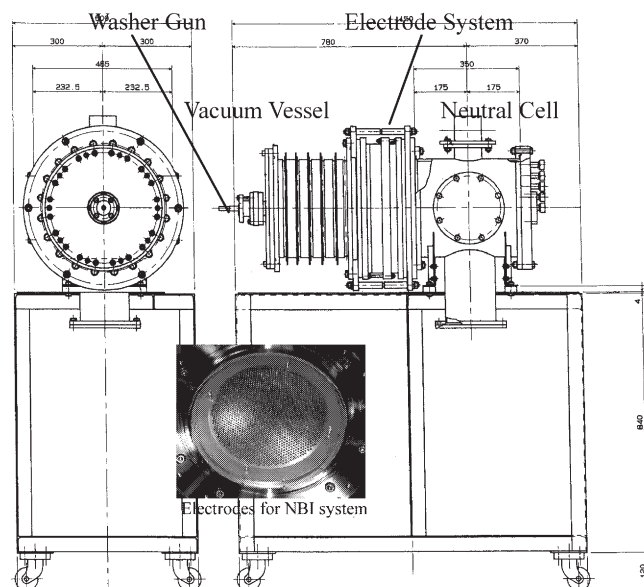


Fig. 1 Low-voltage/ high-current NBI device with washer gun under development.

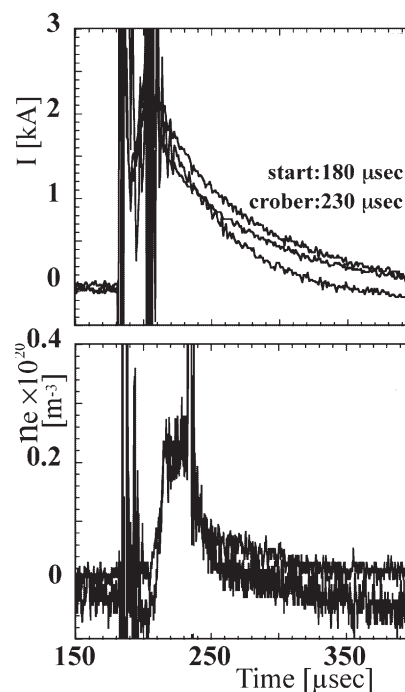


Fig. 2 Time evolutions of discharge current of the washer gun current I (a) and electron density (b).